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University teachers' self-reflection on their academic growth

Helena Pedrosa-de-Jesus^{a*}, Cecília Guerra^a and Mike Watts^b 

^aDepartment of Education and Psychology, Research Centre Didactics and Technology in Education of Trainers, University of Aveiro, Aveiro, Portugal; ^bDepartment of Education, Brunel University, London, UK

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This study followed the academic growth of four university teachers, over a two-year period, with the intention of enhancing inquiry-based learning in practice. Data were generated within the natural settings of classrooms, laboratories and lecture halls, through the analysis of teaching materials, low-participation observation, informal discussions and semi-formal interviews. The research approach was based on a critical social paradigm, assuming principles of action-research methodology privileging a transitional 'instructional coaching approach'. Outcomes show a marked interest in the design and development of innovative approaches to teaching, learning, feedback and assessment. They demonstrated strong collaborative practices, insightful reflections on their teaching activities, and willingness to share evaluations both within and without of university contexts and successfully contributing thoughts and ideas to a wider audience.

Keywords: academic growth; self-reflection; teaching approaches; inquiry-based learning; university teachers; naturalistic methods

Introduction

Many of the changes in higher education that derive from Europe-wide initiatives such as the Bologna process give increased attention to student-centred teaching approaches, allied to growth in teachers' academic development (Higher Education Academy 2011, Clarke and Reid 2013). The need to encourage and support academic development in university teachers is widespread and recognised internationally (for example, Higher Education Academy 2011, Clarke and Reid 2013, Barefoot and Russell 2014). Our current study is one component of a long-standing project focused on promoting academic development and growth in higher education specifically, in our case, in Portugal. Our work since 2001 has provided a strong understanding of the dynamics of student-generated questioning, inquiry-based learning and associated academic practices (Pedrosa-de-Jesus *et al.* 2012).

The current phase of our work entails close institutional collaboration between researchers at the University of Aveiro and at Brunel University London, and interdisciplinary collaboration between colleagues from the Department of Education and the Department of Biology. The primary purpose has been to explore effective ways to facilitate these university teachers' academic development, principally through the

*Corresponding author. Email: hpedrosa@ua.pt

promotion of critical reflection, using naturalistic contexts of collaborative research. The goals are to: work alongside university teaching colleagues in designing and adopting novel practices to meet new demands on their time and teaching; evaluate such innovative teaching and learning strategies in action; and stimulate university teachers' academic reflection on issues of teaching and learning at this level.

This article focuses on a study of cases: four university teachers across the academic years 2012/13 and 2013/14 as we evaluate their academic growth. Our own role has been that of supportive co-researchers, facilitating and enhancing discussion about scholarship of teaching and learning (SoTL) (Boyer 1990, Hutchings *et al.* 2011, Cleaver *et al.* 2014). We adopt the view that SoTL is an essential part of every university teacher's academic practice (D'Andrea and Gosling 2005). Our interest in supporting and furthering SoTL is linked to two trends, as indicated by Kreber (2015), where universities feel increased pressure to:

- (i) demonstrate accountability, to both the public and governments, for the quality of teaching they provide (and thus for how taxpayers' money is being spent), and
- (ii) produce highly skilled graduates (i.e. 'knowledge workers'), who will eventually contribute to local and national communities and, by extension, support the country's economic competitiveness in a global market.

In this context we see SoTL as helping university teachers to be suitably critically reflective about their teaching within a supportive educational community (Ginns *et al.* 2007, Heinrich 2015) and, more importantly for us, to explore students' learning processes (Hutchings and Shulman 1999). In our case, this has taken place within a positive-change environment that has largely enabled academic growth to take place for these four university teachers.

Academic development and growth

The Teaching and Learning International Survey (OECD 2009, p. 49) describes professional pedagogical training and development as those 'activities that develop an individual's skills, knowledge, expertise and other characteristics as a teacher'. In this vein, a report to the European Commission on 'Improving the Quality of Teaching and Learning in Europe's Higher Education Institutions' (European Commission 2013, p. 13) states that: 'A good teacher, like a good graduate, is also an active learner, questioner and critical thinker'. The same report recommends that: 'All staff teaching in higher education institutions in 2020 should have received certified pedagogical training' (2013, p. 64).

Academic growth can be seen as the process that promotes university teachers' knowledge related to teaching, learning, assessment and feedback practices. There are arguments that university teacher development proceeds first by teachers changing their teaching orientation (Gilmore *et al.* 2014) before they can change practice. That is, they must first re-orientate their 'conceptual map for instructional decision making' – commonly from teacher-centred to student-centred – as a prerequisite to changing within the context of the classroom or lecture hall. Our reading of the literature, however, is that there are a vast array of disparate characterisations of teachers and little documented evidence that re-orientation necessarily precedes re-directed practice.

We strongly believe that academics should develop their professional competences about teaching and learning approaches, intentions and strategies (Sadler 2012), and instructional development programmes could be a way to facilitate the SoTL (Trigwell *et al.* 2000, Stes *et al.* 2010, Nevgi and Löfström 2015). The importance of SoTL in integrating the main dimensions of a university teacher's academic work – teaching and research – has been highlighted by many (for example, D'Andrea and Gosling 2005, Cleaver *et al.* 2014). Kreber (2015, p. 111) has defined SoTL as 'formal or informal, critically reflective inquiry into teaching and learning, underpinned by virtues and standards of excellence, directed at promoting the important interests of students'. This form of SoTL lies at the very centre of D'Andrea and Gosling's (2005) model of academic development, and these authors are adamant that all university teachers should develop this kind of research on their practices.

However, a tendency still remains to give priority to disciplinary research, quite commonly an activity divorced from the teaching practices (Trigwell and Shale 2004). Hutchings *et al.* (2011) argue that the role of SoTL should emphasise principles of learning through inquiry (into and about practices and results), collaboration, reflection and action in the service of ongoing improvement of university teachers' academic knowledge.

According to McKinney (2006, p. 39), 'teaching scholarship' involves not only a systematic study of teaching and learning, but also 'the public sharing and review of such work through live or virtual presentations, performances or publications'. That is, these new perspectives need not remain tacit or local. Teachers at this level must present their work to others and share insights with other colleagues about the different ways in which academics respond to growth opportunities in terms of their teaching practice – not only to present and publish their ideas and outcomes as widely as possible, but also to seek both internal and external funding to develop these further. As Kreber (2015) points out, it is to be encouraged through critical dialogue and debate and in community with others.

It is very common that teachers resist change, improvement or suggestions for the development of competences, making it difficult for academic development to take place (Bamber 2008). Crawford (2010), for instance, considers that one of the most critical success factors for teachers' academic development is the existence of a supportive environment for developing and/or sharing of good teaching practices. Authors such as Kezar (2014) and Heinrich (2015) suggest approaching academic development from the perspective of networks; that is, building in cooperation and support among teachers. Kezar (2014), for example, demonstrates the synergy of social network analysis with long-used organisational change theories, and advocates the need to balance organisational perspectives with more attention to networks and social relationships.

In our view, SoTL is a worthy goal, enabling university teachers to be suitably critically reflective about their teaching, within a supportive educational community (Ginns *et al.* 2007, Heinrich 2015) and, importantly, to explore students' learning processes (Shulman 1987, Hutchings and Shulman 1999, Weston and McAlpine 2001). Our over-riding impetus behind teaching, learning, assessment and feedback innovations has been a drive towards increasing teachers' critical questioning and critical reflection (Pedrosa-de-Jesus *et al.* 2014, Pedrosa-de-Jesus and Watts 2014, Guerra *et al.* 2015). Reflective practice implies a level of structured questioning and of systematic review by the teacher that should be carefully considered and often

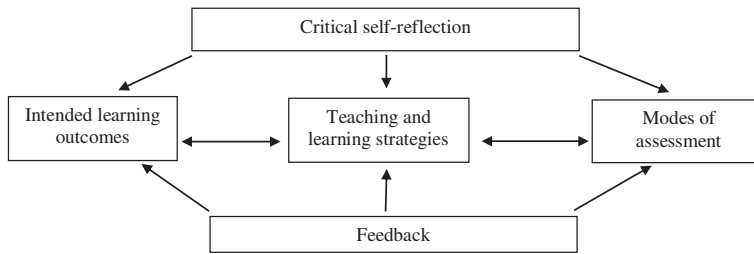


Figure 1. Role of feedback and academic self-reflection on academic growth.

documented (Kreber and Cranton 2000, Clarke and Hollingsworth 2002, Kreber 2002). In our view, then, an inevitable product of teachers' reflection on their teaching practices in this way would be new understandings and altered perspectives of these practices (Clarke and Hollingsworth 2002, van Schalkwyk *et al.* 2013).

In this work we follow Barnett (1997), beginning with the skills required for critical questioning, then progressing through an awareness of the standards of reasoning within disciplines. His 'being critical' is an approach to life to which a university-educated person should aspire, involving dispositions and abilities to think critically in order to act/intervene: 'Critical persons are more than just critical thinkers. They are able critically to engage with the world and with themselves as well as with knowledge' (1997, p. 1). Being critical involves cognitive knowledge, skills and the dispositions to apply those skills in a specific context. This view of critical thinking involves attitudes/dispositions and skills (Barnett 1997, Ennis 1996, 1997, 1998), 'thinking without a critical edge' (Barnett 1997, p. 17).

From this perspective, being critical is part of a dialogue where individuals and group members seek to share in the 'unpacking' of aspects of their individual or shared knowledge and experience, and work through descriptions, analyses, evaluations and critiques of these experiences and the contexts in which they take place. That is, criticality can be developed and enacted in the context of specific subject domains and, as an ultimate goal, could be transferable across disciplines and domains.

A good starting point for us here is Biggs's (1999) 'constructive alignment' between a programme's learning outcomes, teaching strategies and methods of assessment. In our version of Biggs's (1999) constructive alignment, we have added elements of feedback and academic self-reflection (Figure 1).

In this article we add two further elements to Biggs's (1999) original diagram, those of academic self-reflection and feedback. This feedback can take the form of discussions with colleagues at programme level on what exactly the course aims to achieve, 'feed-forward' to students on what they are expected to do to meet the learning outcomes, peer discussions on strategies for teaching and learning, dialogue with students on various classroom approaches, formative and summative feedback on assessment, and so forth. In this way we have traded heavily on university teachers' academic self-reflections, which we sometimes refer to as their 'situated critical reflection' (Malthouse *et al.* 2014).

Building on ideas from Kolb (1984), Schön (1987) and Gibbs (1988), Malthouse *et al.* (2014, p. 600) advocate that 'situated critical reflection' seeks to '... add to the body of knowledge in a way that enables people to make sense of their world by observing the prevailing extended or external influences'. We also argue here and

elsewhere (Pedrosa-de-Jesus *et al.* 2014) that teaching, learning and assessment design must take into account strategies to help university teachers develop their critical thinking competencies. Our previous work provided a rich database from naturalistic settings in higher education, building a model to capture the nature of and foster critical questioning. In our view, generating critical questioners by means of promoting a true spirit of critical inquiry improves the quality of teaching and, consequently, the quality of learning.

The study

We discuss here the academic growth of four teachers (A, B, C and D) and their personal reflections on the progress they make. The four teachers at the heart of this discussion teach different specialities within the Department of Biology: Teachers A and B focused on microbiology and genetics, Teacher C on evolution and Teacher D on microbiology and pharmacology. It is important to note that these four have quite different start-points and quite different ‘growth opportunities’ for their personal trajectories. We give some indication of their personal profiles in Figure 2.

This group of teachers have become involved in the overall project since 2006, accepting new challenges every academic year, always reflecting critically and implementing new strategies and adapting them to their preferred teaching approaches. Teacher A, a senior member of the biology department, known for his good relationship with students and willingness to engage in pedagogic innovation, was contacted personally. He opened his classrooms for observation, tape-recording and exploring new approaches to teaching, learning and assessment. He then suggested other colleagues, also teaching undergraduates, who would join the project. Four more were contacted, all agreed to collaborate and the same core group has been maintained through the years, sharing pedagogical concerns.

We are sensitive to the many factors that can hamper personal professional growth: institutional hindrances such as teaching loads, administrative duties, class sizes, teaching resources, programme requirements, as well as more individual factors such as seniority of role, self-efficacy and group-efficacy and confidence, and personal disposition. Moreover, there is a prevailing institutional tendency worldwide to prioritise disciplinary research over teaching and learning, as an activity commonly divorced from lecture-room practices.

Given this, the academic growth of these four teachers cannot be identical and we discuss their distinctive reflections and reflexive comment rationales in the latter part of the article. In this university there have been external sources of impetus for change similar to those extant in many (most) European universities: the changes required of programmes to accommodate to new intakes of student, of new subject content matter, the introduction of new technologies, of new patterns of learning, of developing practices in teaching – prompted not least by external forces such as the Bologna Process. In our view, university teachers’ academic development is more effective where it involves strong forms of support.

The teaching strategies we discuss in this present article have provided a working framework for organising successful student development, showing how students’ capacity to be critical can be brought into being, developed and honed. Several innovative teaching, learning, assessment and feedback strategies were designed, implemented and evaluated within four curricular units: ‘Microbiology’ (first semester) and ‘Genetics’, ‘Microbiology and Pharmacology’ and ‘Evolution’

University teacher	Institutional position	Years of experience
Teacher A (Microbiology and Genetics)	Full Professor	+/-25
Teacher B (Microbiology and Genetics)	Assistant Professor	+/-26
Teacher C (Themes and Laboratory of Biology)	Associate Professor	+/-19
Teacher D (Microbiology and Pharmacology)	Assistant Professor	+/-18

Figure 2. Personal profiles of the four teachers.

(second semester). Pedagogical assumptions conveyed by the Bologna process (i.e. teaching strategies focused on student-centred learning) have been central to the work developed by this interdisciplinary team.

Figure 3 shows the range of classes that were taught, the forms of online and classroom-based strategies through which innovations took place, and the numbers of students involved.

The research approach

This study was organised into three main phases. During Phase 1, selected teaching materials and other relevant documents of the four curricular units were gathered and analysed. These curricular units constituted the field for action. Phase 2 was the beginning of the empirical work. Innovative strategies were designed to promote innovative teaching, learning, assessment and feedback. During Phase 3, curricular/teaching materials were evaluated for effectiveness. During this phase we also tried

	Microbiology	Genetics	Evolution	Microbiology and Pharmacology
Semester	1 st		2 nd	
Teachers	Teacher A and Teacher B		Teacher C	Teacher D
Number of students	+/-100			+/-40
Courses	Biology (1 st year) Biology and Geology (1 st year)			Nursing (1 st year)
Classes	Lectures (2 h/week) Lab sessions (2 h/ week)	Lectures (2 h/ week) Lab sessions (2 h/ week)	Lectures (2 h/ week)	Lectures (2 h/ week) Lab sessions (2 h/ week)

Figure 3. Organisation of the curricular units 2012/13 and 2013/14.

	Number of meetings	
	2012/2013	2013/2014
Group coaching seminars	4	1
Individual coaching sessions (formal and informal meetings)	13	11
Total	17	12

Figure 4. Instructional coaching meetings.

to refine ways of assessing academics' professional reflection and their academic development.

The research approach is based on a critical social paradigm, assuming principles of action-research methodology (Schmuck 2006, Cohen *et al.* 2007). Our research endeavour adapted three key components of action-research studies (Gray 2004), specifically: a research intention orientated to promote teachers' academic development; a close relationship between researchers and research subjects, in this case the four university teachers and their students; and the reflexivity spiral between the three research phases, which involved strategic planning, followed by implementation of the strategy and its evaluation by critical reflection of the outputs and the design of new and/or complementary follow-up studies.

Our research preference has been for a transitional 'Instructional coaching approach' (Knight 2004, Kennedy 2005, Burkins and Ritchie 2007, Schrum *et al.* 2012). Such an approach entails co-researcher investigations (Macaro and Mutton 2002), which allows each participant to benefit from the enterprise. In this case we collaborated with the four university teachers over two academic years (2012/13 and 2013/14) and, as researchers, had the opportunity to study natural teaching-learning settings.

Research data were collected through a 'participant observation' of one researcher during 29 'Instructional coaching meetings' with the four university teachers and the research group, along with online interactions, mainly throughout email (Figure 4).

The coaching meetings were organised into two forms: 'Group coaching seminars', which involved the whole research group (i.e. six educational researchers, four university teachers and one external consultant); and 'Individual coaching sessions', involving individual formal and informal meeting (before and after classes) with the teachers. The four university teachers had considerable support in enacting, reflecting upon, analysing and evaluating new approaches to teaching and learning. The coaching meetings aimed to: identify educational problems and possible solutions for resolution; design and implement solutions to the educational problems identified; and critically reflect on the solutions designed for those problems identified.

A negotiated schedule of 'low-participant' classroom observations of each teacher was undertaken by the research team. The observed situations were 'authentic' in keeping with the essence of a naturalistic approach (Cohen *et al.* 2007), and were mainly focused on verbal interactions between the stakeholders (students and teachers). All sessions were audio-taped for qualitative analysis.

All of the written documents produced by the participants as a consequence of the research innovations introduced were collected for analysis. There were external sources of information introduced by the educational researchers as they worked and the university teachers, too, introduced relevant papers into the discussions. These were logged and discussed, and commonly appear in some of the contributions to scholarship catalogued in the following sections, focused on academic growth.

Teachers' critical reflections were collected through semi-structured interviews at the end of each academic year (2012/13 and 2013/14). The first part of each interview was aimed at capturing their perceptions about the impact of the research collaboration on teaching and learning experimentation. The latter parts considered teachers' opinions regarding the impact of this collaboration in teachers' academic development and students' learning, respectively. The responses made in the students' and teachers' interviews were transcribed and coded, and we developed a finer-grained analysis of the data to designate their comments.

Since the data gathered were mainly qualitative and descriptive, the principal methodology adopted has been content analysis (Bardin 2009). We used an analytic framework, entitled a Maintenance/Adaptation/Innovation academic practice (MAI model) for analysing university teachers' academic growth. This model is organised into three main dimensions:

- (1) Maintenance practice entails sustaining a teaching, learning, assessment and feedback strategy, without researchers' collaboration, with the purpose of delivering benefit(s) for student's learning;
- (2) Adaptation practice entails adapting a previous teaching, learning, assessment and feedback strategy, one which was developed with this research team (between 2007 and 2010), with the purpose of delivering benefit(s) for student's learning; and
- (3) Innovation practice entails designing a new teaching, learning, assessment and feedback strategy with the purpose of delivering benefit(s) for student's learning.

Research outcomes

Our work aimed to deepen the potential for critical reflection of the four university teachers in a collaborative development scenario (Kezar 2014, Heinrich 2015), the so-called 'Instructional coaching meetings' (see Figure 4). The 'Group coaching seminars' aimed at promoting teachers' critical reflection on the effectiveness of teaching, learning, assessment and feedback strategies developed in different curricular units. The 'Individual coaching sessions', involving individual formal and informal meetings (before and after classes), aimed at developing innovative teaching, learning, assessment and feedback strategies (see Figure 3).

Content analysis of the transcribed reports from the 'Instructional coaching meetings' allowed us to identify teachers' perceptions about, for instances, the major difficulties that may hinder their academic progression, namely: the lack of students' competences (e.g. autonomous learning and questioning competences); the increasing pressure of academic workload, also having responsibilities as researchers in

Strategies	Description	Academic year	
		2012/2013	2013/2014
Microtalk	Conducting 4 lectures by researchers in Microbiology, and filmed by Educast system	Adaptation	Maintenance
Organizational study questions	Designing 80 questions in Microbiology and in Genetics with the intention of guiding students in their autonomous learning	Maintenance	Maintenance
Exploration of microbial world	Conducting a face-to-face sessions in Microbiology with the following aims: to stimulate students' oral questioning; to design questions according to ASI system (acquisitive, specialist and integrative questions) (Pedrosa-de-Jesus and Moreira, 2012).		Innovation
Teacher's oral feedback	Conducting a face-to-face sessions in Microbiology and Genetics in order to give oral feedback to students' questions and doubts	Maintenance	Maintenance
Teacher's written feedback	Sending written feedback (through Moodle) to students' questions and doubts	Adaptation	Maintenance
Scitable	Exploring an online tool with scientific contents in Genetics (Nature Publishing Group)	Maintenance	Maintenance

Figure 5. Forms of teaching experimentation by Teacher A (2012/13 and 2013/14).

their scientific area (e.g. Microbiology); and the extension of the curricular unit and the number of students attending it (between 80 and 200 each class).

The diversity of teaching, learning, assessment and feedback strategies developed by each teacher within each curricular unit along two academic years (2012/13 and 2013/14) was analysed using the MAI model, and crossed with their perceptions. This analysis allowed identifying the teacher's performance concerning their teaching and learning experimentation.

Teacher A

Figure 5 shows some of the forms of teaching experimentation used by Teacher A in curricular units during the two academic years (2012/13 and 2013/14).

Teacher A first attempted the MicroTalk strategy with the aim of stimulating students' knowledge about research in microbiology, in this case the topic of bacteria with antibiotic resistance. Each talk comprised a 12-minute presentation by researchers from the Department of Biology, followed by five minutes for discussion with students. The MicroTalks were filmed using the EDUcast service,¹ making it available on Moodle so that students could re-view them and submit further questions and/or queries either directly to Teacher A or to the researchers. In the early stages, Teacher A saw the implementation of this teaching strategy as an opportunity for students to understand several microbiology topics related to the curricular unit contents. Students found them interesting and asked for the MicroTalks to happen more often. In 2012/13, Teacher A highlighted three teaching strengths:

First, is to bring authentic research to the classrooms, which is related to my own research group ... Second, is to show some diversity of topics in microbiology in a concrete way. Third, it shows that research is an activity that people can do. It can be a profession. Students have the opportunity to see real researchers and can question them, can discuss issues. (First interview)

He felt it allowed students to expand their knowledge about microbiological research; however, he did not formally evaluate the impact of this strategy on students' achievements:

I do not know if this had an impact on assessment ... it may have had an impact in medium terms rather than on immediate assessment. (Second interview)

During 2013/14 a new session was implemented entitled 'Exploration of Microbial World'. This development allowed Teacher A to focus on the scientific information captured through students' questions. Our previous project (Pedrosa-de Jesus and Moreira 2012) had encouraged questioning as a strategy for developing students' learning:

My perception is that this session went very well and it was very productive. The fact that some students asked some questions ... there were not many questions ... but those that were asked served as a starting point to explore the theme, and others connected to trigger discussions about other topics. And ... just for this it has been very useful ... (Second interview)

Based on this, Teacher A also asked his Microbiology and Genetics students to respond to questions using Moodle. Their task was to select the top-five most complex questions he had placed there and look to see whether they could find the answers through Internet and book study. He reflected on the strengths and constraints of this teaching strategy by saying that:

The questions I put there have been designed with some spontaneity! That is, they are not taken from a book ... nor exist, for example, in exams from previous years. Sometimes these [questions] have emerged during my lectures or from something that I felt was not clear, questions that students ask me or from a discussion that students had with me at the end of the lecture. (Second interview)

Teacher A was aware that collegiate meetings were consonant with a broader drive for change within the university:

The fact is that an external push exists ... a kind of audit. Well I don't think it is exactly an audit, but there is a need to change every year with reflection on what is being done and, therefore, this [the meeting] has been very important. (First interview)

He continued by noting a more concrete aspect of joint practice:

Another positive impact was that we were able to record MicroTalks. We would not have done this without this collaboration. The fact that all teachers have to talk to an outsider [educational researcher] who asks them questions is a very significant aspect for reflection about what we are doing. (First interview)

The teacher also considered the very positive potential of using 'Scitable' in Genetics. He stressed the potential of this online learning tool by stating that 'it is a good base to have as a starting point of information. And then it leaves an open door for those [students] that are more interested in certain topics and want to explore it more' (first interview).

Strategies	Description	Academic year	
		2012/2013	2013/2014
<i>Online questionnaire</i>	Designing an online questionnaire with a presentation of a practical problem in Microbiology. The aim was to stimulate students' questioning, submitting questions for its resolution	Adaptation	
<i>Rubric assessment questionnaire</i>	Drawing a rubric with assessment criteria for the students' responses of the online questionnaire in Microbiology	Adaptation	
<i>Mini Questionnaires</i>	Designing 5 short questionnaires in order to promote students' involvement in the preparation of laboratory classes of Microbiology and Genetics		Innovation

Figure 6. Forms of teaching experimentation by Teacher B (2012/13 and 2013/14).

Teacher B

Figure 6 shows some of the forms of teaching strategies used by Teacher B in curricular units 'Microbiology' and 'Genetics' during the two academic years (2012/13 and 2012/14). Teacher B appreciated the importance of questioning and commented her own practice through alignment between teaching, learning and assessment:

These are two very important aspects: the matching between teaching strategy and modes of assessment and, on the other hand, the appreciation of the question-answer process. ... This dialogic process as a learning tool is very valuable. And, it turns lectures into becoming much more interesting. (First interview)

Teacher B highlighted the collaboration with colleagues from the education department, stating that it should be considered to be a form of scientific collaboration:

Teachers' awareness to enhance their own [academic] performance and the collaboration with colleagues from the didactic department, as experts, should be valued ... it turns out to be a scientific collaboration. (Second interview)

Teacher B also shared her view that their work should be valued not just in terms of developing teaching competencies, but also in terms of scientific production (i.e. papers):

The image that we reveal in our classes will be increasingly valued [in higher education] ... that is, our ability to attract students [to higher education]. It is not only our scientific success and the published articles, but also our ability to receive and train students well. (Second interview)

Teacher C

Figure 7 shows some of the forms of teaching, learning, assessment and feedback strategies used by Teacher C in curricular unit 'Evolution' during the two academic years (2012/13 and 2013/14).

This teacher developed a task requiring student 'critical analyses' related to the topic of evolution. Students worked in groups and the teacher provided written group-based formative feedback for the task:

This feedback exercise involved a lot of work. Because... the feedback was given as follows: first I did an overall assessment ... therefore, I had for each group an Excel sheet where a general review of the critical analysis was registered and then I

Strategies	Description	Academic year	
		2012/2013	2013/2014
Critical analyses	Producing critical analyses of a selected press note related to the topic of evolution (i.e., the advent of genetic diseases) – group work	Innovation	Maintenance
Teacher's written feedback	Sending written formative feedback of critical analysis(through email) to 21 groups of students	Innovation	Maintenance
Students' written feedback	Sending written formative feedback of critical analysis (through an Excel document and email) to 21 groups of students		Innovation

Figure 7. Forms of teaching experimentation by Teacher C (2012/13 and 2013/14).

reviewed, in detail, the entire critical analysis. Each document handed in has x text lines and each of my comments been reported to line y or z. Those comments really, in my perspective, were made in order to improve the groups' critical analysis, sometimes aiming at a better 'speech articulation', a better prose. Other times, I simply asked for a better scientific support of their statements. Frequently, I also advised them to add references supporting what they were saying in the critical analysis and, therefore, this gives me some work". (First interview)

The teacher considered that the task allowed him to develop students' competences, such as 'selection and evaluation of scientific information', and 'group work collaboration':

I really think that this activity promoted students' critical reflection. On the other hand, it also promoted the collaborative group work, since, as you know, the groups could go up to five elements. And therefore only for that it was worth it. The fact of knowing how to work in a group, accepting others' opinions ... and that is not always easy. To develop and write text documents, to search ... I think it was worth for all of this. (First interview)

However, the following year he recognised that providing extensive written formative feedback to 21 groups involved a huge effort in terms of the time commitment:

I have maintained the critical analysis task this year ... However, some 'nuances' were introduced, particularly the kind of feedback I have sent to groups. In some of the situations, I made suggestions for changing, in other cases, I even wrote that they should amend or re-structure specific sections of the critical analysis. So, I gave some feedback, playing the role of a 'journal referee' for this critical analysis. And this that part had not existed in previous years. (Second interview)

This particular task of critical analysis entailed a considerable amount of work both from the teacher and the students. Teacher C was aware that these were first-year undergraduate students:

We are working with 18 year-old students just arrived at the university ... and it is just a curricular unit for them. I think the effort these students have developed for the accomplishment of this learning activity was high. It was necessary to read texts, to analyze the texts, and not everyone is prepared to do that. It is actually a fact – we [the teachers] have no time to do this kind of work. (Second interview)

He took the opportunity to peer-observe classes of other university teachers:

I had the opportunity to be a non-participant observer, when groups were developing their critical analysis; I think it would be extremely interesting for me in order to

understand the dynamics of some groups. Obviously, they probably would not feel comfortable with the teacher looking at their work and listening to them. I have the idea that most of the work was developed during the evening, interacting through distance web tools, email, etc ... (First interview)

When asked about the effect of these innovations on his classroom practice, he recognised that it was very useful since it helped him to better align teaching with learning outcomes, and therefore change the way he taught. He stated that:

As a teacher, these strategies are extremely enjoyable since I'm going to the lectures always taking something new. I'm not going just to transmit knowledge for students to memorize and then they go to the exam ... no ... this is a deliberate strategy having a specific purpose, where all the intermediate steps are planned in order to maximize the final result [the students learning outcomes]. Therefore, this is what I most value in these strategies being develop during this curricular unit as a result of this collaboration. (First interview)

Teacher C also noted the need for the university organisation as a whole to be more committed to the development of such interdepartmental collaboration projects:

There was no upstream work to prepare the ground, for example, in terms of distribution of the teaching service. I think these (inter departmental) projects are extremely useful if we teachers want to participate ... and collaborate. The university should be aware of this type of collaboration and should arrange conditions in order to enable the different outcomes that the project wants to achieve ... and, for example, that could be in terms of teaching duties [i.e. number of teachers attached to each curricular unit] ... (Second interview)

Teacher D

Figure 8 shows some of the forms of teaching, learning, assessment and feedback strategies used by Teacher D in the curricular unit 'Microbiology and Pharmacology' during 2012/13 and 2013/14.

Strategies	Description	Academic year	
		2012/2013	2013/2014
Questions online	Designing an online questionnaire, which requested students' questions about Microbiology	Adaptation	Maintenance
Teacher's oral feedback	Oral feedback (through Moodle) to questions in Microbiology online	Maintenance	Maintenance
Teacher's written feedback	Written feedback (through Moodle) to questions in Microbiology online		Adaptation
Mini Questionnaires	Designing 5 short questionnaires in order to promote students' involvement in the preparation of laboratory classes of Microbiology		Innovation

Figure 8. Forms of teaching experimentation by Teacher D (2012/13 and 2013/14).

When interviewed, Teacher D recognised that she had started spending more time asking questions during classes:

... I have started to ask them more questions, giving them more time for finding the answer. That is, giving them this opportunity, sometimes even providing some 'clues'. I have been using this strategy in order to make them think and organize their ideas... I think I have changed a few things during the project.... (First interview)

Being surprised by students' lack of preparation for laboratory sessions, she instigated a question system at the beginning of a session in order to check that students had read the preparatory work before arriving at the session:

... It has required them to read the practical protocol [lab sessions] because when they read a protocol they will know what they will do in lab lessons ... and take much more advantage of the lab sessions than if they do not prepare in advance... which has been what happened most of the time. They did not read the lab protocols, and then they did not know what they would have to do. (First interview)

Later, in the second year of the project, she reflected back on this:

... from my point of view... It was the best strategy in order to take more advantages of the practical classes, and motivate students to read the practical protocols. And, of course, you must always integrate this kind of activity in students' assessment, because otherwise it will not result ... (Second interview)

When reflecting about the impact of this research collaboration on her academic development, Teacher D was very positive:

Yes, it had some good impact. Let me think ... I reduced the contents in the discipline... I also have been asking more questions to the students, from year to year. I have also been trying not to respond in advance to questions. I think I have done that in the beginning [of the research project] ... but now I try to give them [students] indirect clues, in order they could answer at least, they could figure out what was intended with that particular question, and try to articulate the contents or apply them in a practical way ... (Second interview)

Discussion

The various forms of disciplinary and interdisciplinary 'Instructional coaching meetings' entailed colleagues to make explicit to each other some of their pedagogic content. They did this through face-to-face and email conversations, commenting and advising on each other's ideas and their implementation, and organising peer observation – meanwhile 'nudging' the university to take this kind of activity seriously. As can be seen in these short interview extracts, the list of 'innovations' includes working with a 'questioning colleague', personal reflection, instigating, restructuring course content and developing classroom questioning strategies, amongst many more that were discussed elsewhere.

In reference to the MAI model, there were few examples of 'leadership' by anyone of the four university teachers. So, for example, Teacher A decided to apply for national funding (Fundação para a Ciência e a Tecnologia, FCT), including Teachers B and D and two of the educational researchers as team members, intended as follow-up research on teaching. The project submitted was entitled 'MicroTEMAS – A strategy for promoting Microbiology students autonomous learning competencies'. The purpose of the project was to develop a 'virtual space' for learning in microbiology, linking formal with non-formal higher education (e.g. use of 'massive open online

courses’). Although the project was not selected for funding, we consider this a SoTL indicator (D’Andrea and Gosling 2005, Hutchings *et al.* 2011, Kreber 2015) where the teacher was autonomous in seeking to transfer their academic knowledge to other educational contexts, knowledge developed principally throughout this collaboration.

While, as already noted, they occupied different departmental roles and status in relation to each other, they tended to work easily and collaboratively together, each one taking different initiatives at different times, moving the spotlight around within the group. In addition, while they contributed to university initiatives as discussed in the following, they were rather more pre-occupied in ensuring ideas were tested and embedded in their own practice than leading innovations at university level.

SoTL is focused on university teachers’ academic development by: drawing on literature and research on teaching to inform practices; publishing and make presentations about teaching and applying for funding for research on teaching. In general, university teachers certainly grew in their understanding and appreciation of SoTL through these activities (Boyer 1990, D’Andrea and Gosling 2005, Hutchings *et al.* 2011, Cleaver *et al.* 2014, Kreber 2015), engaging them in the complexities of teaching and learning at this level. Some indications of the ‘SoTL products’ have emerged from the project. They range from contributions to internal university teaching and learning events, to external international conference presentations (Guerra *et al.* 2015). Three teachers were actively involved in the dissemination of results of the project in conference presentations (for example, Guerra *et al.* 2015). Results were updated on the project website (edaun.web.ua.pt) using feedback and inputs from all team members.

In our work, the four university teachers were not content just to innovate and reflectively evaluate the developments in their teaching; they used the collaborative research process in order to gain access to a world different from their own specialist fields. While they are all involved in academic scholarship within their own disciplines, they undertook to present and publish within SoTL.

SoTL ‘academic growth opportunities’

This article presents a study of collaboration between educationalists and four university biology teachers across the academic years 2012/13 and 2013/14, and weighs the impact on these teachers’ academic development and growth. As indicated at the start, our main goals have been to: work alongside university teaching colleagues in designing and adopting novel practices to meet new demands on their time and teaching; evaluate such innovative teaching and learning strategies in action; and promote university teachers’ academic reflection on issues of teaching and learning at this level.

Making changes to university teachers’ conceptions of teaching and learning in the context of higher education is difficult and challenging. From the beginning, our work has been focused on understanding just how to promote university teachers’ academic development (Clarke and Reid 2013, Barefoot and Russell 2014) throughout the design of innovative teaching, learning, assessment and feedback strategies. Our collaborative study shows the extent to which experimentation with innovative strategies by this group is strongly influenced by their particular conceptions of teaching. Results from classroom observation, individual and group meetings and teachers’ individual interviews indicate how they have interpreted their academic experiences concerning the design of innovative strategies. They expressed the

benefits of this co-research work for their auto and hetero professional reflection and the implications on their academic growth.

We have generated data from the naturalistic settings of classrooms in action and face-to-face conversations and discussions, and have organised the data using an analytical framework for academic development (MAI model). This allows analysis of these university teachers' ability to enact upon their teaching and the changes in their critical thinking. Although we consider the model to be very informative and useful for our purposes, we also think it should be improved and refined for future work. It is a complex task when we try to 'measure' 'teacher's academic development'. However, we consider it very important for promoting their academic reflection and growth. There are drawbacks and limitations to conducting naturalistic research, not least forging a balance between the number of participants possible given the depth, richness and complexity of the data generated over this kind of timescale. The sample in this article is small and, necessarily, drawn from a very specific locale and working context. We do not feel, however, that this detracts from the quality of the growth evidenced, and the time span involved – over a two-year period – has allowed us to chart the development of these teachers in considerable detail.

One key benefit has been the close collaboration between colleagues. This has occurred across different disciplines, departments and institutions, resulting in new ideas and shared understandings. As Barefoot and Russell (2014, p. 161) note, such collaborations can enhance discussion of 'how I can improve students' experiences' of learning and assessment within a discipline-specific context. The four teachers here introduced a number of innovations to their teaching such as MicroTalks, peer observation, using students' own questions on Scitable, tasks for critical thinking and analysis, and the like.

SoTL happened in the classroom, in committee meetings and in engagement with students and colleagues (peers and educational researchers) as mentioned by other authors such as Boyer (1990), D'Andrea and Gosling (2005), Hutchings *et al.* (2011), (2014) and Kreber (2015). In this instance, academic development has occurred when something discussed during the 'Instructional coaching meetings' and/or 'individual interviews' have generated change in university teachers' self-academic reflection in their experimentation practices and the salient outcomes of their practices (academic growth and students' learning). Their overall comments on the project are unequivocal and pleasing. They would not have undertaken and benefited from this kind or level of educational enquiry without the collaborative input and support from each other and from educational colleagues. Their analysis and evaluation of the innovations is clear. While they weighed the benefits to students, each teacher was also acutely aware of any new demands on their own time and teaching. Some innovations were patently attempts to be time and labour saving, and others were undertaken in the understanding that they made considerable extra call on personal resources.

On the whole they, too, have been pleased with the outcomes, resolved in places to continue to refine their own approaches and, in others, to try ideas from their colleagues. Their reflections are measured and focused, exploring what exactly happened in certain circumstances, what sense to make of it and what was significant. In the final section they also make 'situated' and reflexive comments, where they discuss the role of the institution, and how their own professional practices play sometimes with, sometimes against, organisational structures and contexts.

As Bolton (2014, p. 8) points out, being reflexive is a struggle against a sense of immutability, of ‘it’s just how things are’ or ‘it’s just common sense’. These teachers were prepared on occasions to occupy uncomfortable spaces. Of particular note is the extent to which these colleagues have engaged in scholarship outside their discipline areas. It is not just Weston and McAlpine (2001) who see this as a worthy direction, Cleaver *et al.* (2014, p. 14) also argue that, equipped with high-level enquiry-based skills, ‘academics can move beyond a synthesis of the latest thinking, research and scholarship within their subject area, to actively enter into and lead debates about appropriate modes of teaching and good practice in facilitating student learning’.

We see some of this in our work where, as we have illustrated, while they may not yet be leading, these teachers have certainly entered and contributed to the debate at local, regional and international levels. To this extent, we can see considerable growth both down and across the analytical framework model (MAI model) we propose in this article. Nevertheless, there is always room for further research.

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Note

1. Available online: <http://www.ua.pt/stic/PageText.aspx?id=14306> [Accessed 9 October 2013].

ORCID

Mike Watts  <http://orcid.org/0000-0002-8044-5418>

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